STRATEGIES OF MASTERING A VISUAL COMMUNICATION SYSTEM IN APHASIA*

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INTRODUCTION

The recent devising of a new form of aphasia therapy has provided an opportunity to investigate the ability of the severely aphasic patient to communicate in other than his natural language. In this therapeutic innovation called VIC (for *VIsual* *C*ommunication), messages are written on index cards which are laid down from left to right. The patient initially observes others as they communicate with the system; eventually he is drawn into the interchanges, first as a "comprehender," later as a "producer" of messages. Goals of the VIC program, methods of instruction employed in daily therapy sessions, and the degree to which patients have demonstrated success in mastering the system have been detailed elsewhere (e.g. Refs. 1–3). A few points about VIC should nonetheless be noted here.

First of all, two levels of language use are entailed in the system. At Level 1, three communicative functions are taught in the following order: 1) carrying out commands; 2) answering questions; 3) describing events. For patients who master these tasks, Level 2 training explores their ability to express feelings and immediate needs via this alternative mode of communication. The degree of success achieved by patients has been documented both in quantitative terms[3] and by means of case studies.[3,4] Finally, in what follows, the various ideographic and arbitrary geometric designs which refer in VIC to particular objects and elements have been termed *symbols*; as symbols, they carry the *semantic* or *referential* portions of the VIC system. The formal relations that obtain among these symbols when they are organized into messages have been considered the *syntax* of VIC.

Given that patients can master one or both of the levels of VIC, and that the system has a place in rehabilitation, questions of fundamental theoretical importance remain. To begin with, just what are the patients learning: an elaborate game (cf. Brown,[5] Lenneberg,[6]), a genuine language-like communicative system, or perhaps some hybrid? And relatedly, by what means do those successful with VIC acquire its basic components:[6] by sudden insights, trial-and-error, or a gradual series of steps? By examining the ways in which principal features of VIC are acquired, insight can be gained into the function served by the system, patients' grasp of the essential features of the system, and the relationship between VIC and other systems of communication employed by primates, infrahuman as well as human.

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APPROACH

Given our interest in communication within a language framework, we shall deal with the questions posed above by focusing on the acquisition of four constructions generally deemed central to language. In doing so, we shall use a vocabulary and a framework drawn from work on semantic relations.[7,8] This approach has become regarded increasingly as a useful way of describing adult language and, in recent years, has been applied as well to early language use by young children.[5] By tracing through the events that mark the acquisition by aphasics of these semantic relations, we expect to gain insights about the general processes involved in acquiring a new symbol system, as well as the particular demands and problems posed by specific semantic relations.

It must be noted that, in describing various configurations of VIC as semantic relations, we are making an assumption about the functions assumed by particular symbols. It may well be that patients can utilize the system without possessing a genuine grasp of the relevant semantic relations. However, for the purposes of exposition, and with the understanding that we are propounding a testable hypothesis, we shall continue to refer in what follows to four basic semantic relations.

The following VIC utterance illustrates the semantic relations to be discussed here:

> John put pencil in glass and give comb (to) Brian.

The *agent-action relation* obtains between the symbols for "John" and "put," as well as the symbols for "John" and "give." The *action-object relation* obtains between the symbols for "put" and "pencil," and the symbols for "give" and "comb." The *action-location relation* obtains between the symbols for "put" and "glass." The *action-beneficiary relation* obtains between the symbols for "give" and "Brian." Patients who master these semantic relations and can employ them flexibly and productively may be said to use VIC as an effective means of communication. Because of our interest in detailing the processes of VIC acquisition, we will focus in this account on patients who did not initially apprehend the system but who eventually came to master the system in an apparently appropriate manner.

To determine the manner in which VIC patients come to appreciate these semantic relations, a simple recording of number of correct and incorrect responses is clearly insufficient. Accordingly,. protocols describing each VIC session include detailed descriptions of strategies by which patients arrive at various responses, types of errors committed, and reactions by patients to negative feedback. Such descriptions constitute the principal source on which patient mastery of the various semantic relations is assessed.

PLAN OF PAPER

In the following sections we first examine some general patterns of symbolic mastery observed in a variety of patients and then focus on the course of mastery of each of the four semantic relations. Whenever a particularly revealing strategy demonstrated by a single patient is described, his initials will be noted; otherwise, descriptions pertain to progress or regression typifying a majority of VIC learners. A general discussion section will review the findings as they bear upon the question of whether the system is being utilized as a legitimate vehicle of communication. Throughout the paper, and particularly in the final sections, a comparative perspective vis-à-vis two other groups learning first symbol systems will be maintained.

Literature describing early language use by normal and abnormal children and the recent developments in teaching of symbol systems to infrahuman primates will be considered. By means of this discussion, the central issue of whether the various populations are learning a language or a game will once again be confronted.

GENERAL BEHAVIORAL STRATEGIES

The patient entering the VIC program brings with him—and employs—a raft of earlier schemes, or behavioral patterns, for dealing with new situations. His attention in initial encounters with the system is focused on *random exploration of cards and objects*, with little or no evidence exhibited for appreciation of the cards' potential value as symbols. Cards and objects are manipulated indiscriminately; cards placed on top of, underneath, next to, or inside various objects may or may not depict those objects.

In these early encounters with VIC, the patient bears a certain resemblance to the young child in the latter half of the sensorimotor stage of cognitive development (cf. Piaget[9]). Certainly, knowledge of the substantiality of objects independent of his own experience is an integral part of the patient's schemes for dealing with VIC. Yet, unaware of the cards' symbolic value, the patient displays no need to "make sense" of the cards. More generally, the patient exhibits a lack of differentiation among the major components of symbolic communication: the addresser, the addressee, the vehicle (or symbol), and the referent (or object to which it refers).[10]

Following a period in which he observes accomplished VIC users employing the system, the patient is gradually drawn into the "conversation." Paralleling Piaget's description of early symbol use by the child, the patient's first attempts to find meaning in the cards are typically demonstrated through *use of gestures*. Presentation of the "comb" symbol card may be met by a combing gesture over the head, the "pencil" symbol card by a writing gesture, and so on.

As the patient becomes more experienced in the use of VIC cards as symbols, the initially observed gestures tend to drop out of his response pattern. Even at this point, however, the patient exhibits an *incapacity to differentiate between the cards as objects and the cards as symbols*. Instructed to "pick up the comb," he may instead pick up the "comb" symbol card used in the utterance, and thereafter continue to make errors of this type, even though each error is corrected immediately and the appropriate response demonstrated. As the patient acquires more experience with the system, however, confusion of card and object also tends to drop out of his response pattern.

Concomitant with, and facilitated by, gradual *appreciation of the object cards as distinct from their symbolic function*, the patient comes to accept the potential symbolic value of the other cards to which he is exposed. Indeed, he comes to expect that each card has its own symbolic function; when confused about the "meaning" of a particular card, he may point to it and, via gesture, facial expression, or stereotyped speech (e.g. "I don't know"), designate it as the source of his confusion.

Eventually the patient's appreciation of the symbolic function of VIC cards reaches a level of sophistication at which he appreciates, and can use as such, the symbol cards as members of "VIC form classes" (i.e., names, verbs, objects, and grammatical morphemes—conjunction and prepositions). As noted in Gardner *et al.*,[3] the bulk of errors committed by patients in the production of VIC utterances is of the "same category" type—i.e., the patient substitutes for the correct symbol another member of the same form class (e.g., verb A for verb B). "Different category" errors (such as use of a verb symbol where a name or object symbol is required) constitute across patients only about 3% of the total number of errors committed. Errors committed in the execution of commands also consist of confusing one verb for another, one object for another, and so on; however, the demand characteristics of the situation—i.e., "do something"—make this necessarily the case and therefore of limited interest.

Further support for *appreciation of form classes* is found in the skill of successful VIC patients in sorting systematically their own sets of cards into piles that define the various form classes. In addition, a number of instances have been noted in which patients, having observed the use in commands of new VIC symbols (e.g., name cards for communicators new to the VIC sessions; verb and preposition cards seen for the first time), place the cards without hesitation in the appropriate form class piles.

This level of sophistication precedes the final step necessary for successful VIC mastery—*appreciation of the formal relations obtaining among symbols* when they are organized into meaningful utterances. Required here is the capacity to perform certain computations or procedures of the sort specifically entailed in natural language—e.g., attending to syntax, or word order, so as to apprehend the various grammatical and semantic relations between the verb and the accompanying nouns in a given utterance. Put differently, given that the patient can respond to and utilize the referential function of individual symbols, successful VIC mastery requires, in addition, appreciation of the predicative function of utterances comprised of these symbols—i.e., the use of VIC utterances not only to refer to various elements (topic) but to make certain statements (comment) about those elements (cf. de Laguna[11]).

The foregoing discussion has outlined a typical pattern of strategies as it emerges during the course of VIC mastery. It is not the case, however, that a strategy makes an appearance at an appointed time and then is replaced smoothly and permanently by a more sophisticated pattern of behavior. Rather, exemplifying a well-documented pattern among brain-damaged patients,[12] VIC acquisition is marked by repeated regressions to earlier and more primitive modes of dealing with the system. Particularly when a new and more complex utterance or utterance type is introduced, patients may fall back on earlier strategies, sometimes indeed acting as if they had completely forgotten their most recent level of understanding. Evidence of general progress in VIC does come, however, from the observation that patients who have mastered a substantial portion of the system are more likely to regress to a fairly sophisticated level of mastery than to one of the earlier and more primitive modes of response.

Having reviewed some of the general response patterns which characterize VIC users as they attain the basic levels of the system, we move now to a discussion of strategies employed by patients in coming to grips with the predicative function of the various semantic relations expressed in VIC.

STRATEGIES ASSOCIATED WITH SPECIFIC SEMANTIC RELATIONS

The Action-Object Relation

The early stages of VIC acquisition consist for the most part of readily discernible actions that require gross manipulations of a specific set of familiar objects. As such, the action-object relation receives first and primary focus and continues thereafter to be of crucial importance in successful mastery of the system. The patient John confronted with the command "John pick-up spoon" must appreciate not only the symbolic function of the action and object cards, but the relation between the two—i.e., that the object referred to is to undergo a change of state *as a result* of the action referred to.

Typically, early patient strategies exhibit a tendency to respond to each card separately. Instructed to "pick-up the spoon," the patient locates the spoon, places it below its symbol card, and then raises his empty hand over his head. The symbolic function of each card is appreciated; the predicative function of the formal relation between them is not. The patient successfully interprets each "topic" referred to in the utterance; however, he demonstrates little or no awareness of the "comment" realized in the utterance by virtue of the relations among the elements contained therein.

Patients often display a rather obvious and instructive strategy that proves unique to the mastery of this and, later, the action-location relations. Requested to pick up the spoon, the patient locates the spoon, places it below its symbol card, looks to the verb card, and *then* picks up the spoon. Unlike the earlier strategy of locating the spoon and raising an empty hand, this strategy demonstrates that the patient has now successfully processed the comment as well—and in fact does so in an orderly fashion. However, he remains unable to combine topic and comment in a single seamless action; he must still execute the command in steps.

Eventually, this "two-step" execution of the command tends to be replaced by a single smooth execution. However, the less advanced strategy may reappear when a new construction is introduced. For example, the patient may return briefly to the strategy of responding to each symbol card separately, as did one patient (J.S.) when first confronted with the newly demonstrated command "give fork (to) Brian" (a third party in the room). After locating the fork and placing it beneath its symbol-card, J.S. then swept his empty hand over the table and into the hand of a rather startled Brian. Other analogous regressions may also occur. However, the incidence of errors due to generalized regression tends to decrease as the patient becomes more familiar with the system, much as the child learning to ride a bicycle falls off less frequently, even though he may be mastering more difficult riding techniques.

The Agent-Action Relation

The patient's initial encounter with VIC includes assignment of an arbitrary design representing his VIC "name" and parallel exposure to the names of other VIC communicators. Unlike the young child, for whom a confusion among proper names is common,[13] the patient generally experiences little difficulty in appreciating the symbolic function of these cards. Further, the patient generally learns quickly that the name symbol card appearing at the beginning of a command utterance designates the person who is to perform the indicated action, and attains a high degree of success in responding only to those commands directed to him. Inappropriate responses (e.g., patient executes a command directed to another VIC communicator) are easily corrected by pointing out the name symbol card at the beginning of the utterance, and indeed, often corrected by the patient himself before he has completed the indicated action.

In the face of what might appear to be almost immediate appreciation of the agent-action relation, the following question arises: Does the ability to respond only to those commands with the patient's name symbol card at the beginning of the utterance necessarily indicate appreciation of the agent-action relation? That is, can one infer appreciation of the predicative function of the formal relation as one that implies, in the notion of agent, a motivating force that causes or instigates the action? Clearly, the patient could respond in the appropriate manner by responding to the symbolic function of the name and verb cards separately, perhaps even perceiving the name card to be a sort of attention-getting signal on the order of "You! Pick up the spoon."

A firmer index of the patient's mastery is provided by his performance when instructed to describe an action by another VIC communicator, or to answer a question about a similar event (e.g., "Who is-picking-up the-spoon?"). Most patients succeed at these tasks; moreover, use of the wrong name symbol card in describing an action by another VIC communicator is easily corrected by simply pointing out the name tag of the person executing the action indicated in the utterance.

One patient (G.S.), however, experienced continuing difficulty in determining the correct name symbol card to use in describing an event that had just occurred in his view. With apparently no insight into what was expected, he would place at the beginning of an otherwise correct utterance an incorrect name symbol card—for example, one referring to a VIC communicator in the room who had not committed the action in question or sometimes even to himself or a VIC communicator who was not present at the time. When corrected, he would shrug his shoulders and point to the other people present, to himself, or to an empty chair that had been occupied previously by another person. To be sure, he could respond appropriately to commands directed to him and could match as many as five name symbol cards with their appropriate referents, even when these referents were not wearing their name tags. However, his difficulty in determining the agent of a particular action and expressing it in an utterance of his own persisted, suggesting a fundamental difficulty in either his concept of agency, *per se*, or his ability to capture this concept in symbolic form.

The Action-Beneficiary Relation

More complex constructions of the type "John give spoon (to) Brian" are not introduced until the patient has demonstrated mastery of the relations described above. As a result, and perhaps due also to the fact that the concept of "beneficiary" is an integral part of the action "to give," several examples of such commands, directed to another VIC communicator, generally suffice to convey to the patient the expected response—that of giving the object or objects denoted to another VIC communicator.

An utterance of this type contains two name symbol cards that relate by virtue of their respective positions in different ways to the action symbol card. Accordingly, it is incumbent upon the patient to rely on syntax, or word order, to determine the predicative function of the various relations that comprise the utterance as a whole. In this respect, the action-beneficiary relation proves more demanding than the two discussed above.

Early difficulty in dealing with such a condition is of a specific and not unexpected variety; that is, the patient responds to commands directing another VIC communicator to give an object to the patient by locating the object himself and giving it to the person to whom the command was directed. Thus, rather than failing to appreciate the action-beneficiary relation, the patient is unable to use the respective positions of the name symbol cards to determine which is the agent of the action and which the beneficiary. It might be said that confusion of this sort exemplifies the generalized regression described above—i.e., introduction of a new construction undermines previously indicated mastery of an old construction.

In most cases, appropriate response to the previously mastered construction (agent-action) recovers quickly and in fact proves instrumental in solidifying success with the action-beneficiary relation. The patient demonstrates this success by giving an object to the indicated person when directed to do so and by waiting, sometimes impatiently with his hand outstretched, when another VIC communicator is directed to give an object to him. One patient (J.S.), in an apparently inadvertent but instructive error, exemplified his use of word order to determine the beneficiary of the action "to give." Responding to a command directing another VIC communicator to give an object to him, he located the object himself, looked to see which name symbol card was at the end of the utterance, and attempted—by passing the object from his left hand to his right hand and then holding it against his chest—to "give" the object to himself.

The patient's use of word order in mastering the action-beneficiary might be challenged, inasmuch as the utterances directed toward the patient are semantically constrained. That is, shown the cards "spoon" and "Brian," the patient naturally hands the spoon to Brian, rather than attempting to hand Brian to the spoon. Firmer determination of such mastery can be forthcoming if other verbs entailing a beneficiary relation are used, or utterances in which the object and beneficiary might be interchanged—e.g., "Give the baby dog to Raggedy Ann." We have not yet had the opportunity to attempt such modifications.

The Action-Location Relation

Constructions of the type "John put spoon in glass" and "John put spoon in box" are similar in two ways to the action-beneficiary constructions. First, they are not introduced until the patient has demonstrated sufficient mastery of the action-object and agent-action relations and, indeed, has come to expect the predicative function of VIC utterances. Second, attention to syntax is necessary for a determination of which of the two objects referred to in the utterance is the location of the indicated action. However, correct performance may sometimes come about as a result of the cards considered independent of word order. This is because the compelling concavity of the glass and the box allows the patient to rely on the identifying features of the objects rather than the positions of their respective symbol cards to determine the appropriate response. Whether this strategy is in fact being utilized can be tested in various ways.

First, the patient may be directed to place the glass inside the box, or the box inside the glass. Because either object can serve as the container for the other, the appropriate response to each command must be based on the word order of that particular utterance. Second, prepositions other than "in" may be introduced. Correct response to commands that direct the placement of one object on top of, to the left or right of, and in front of or behind, another object also requires that syntax be used to determine which object is the location.

In dealing with the various commands just described, the patient typically evolves a strategy that indicates his awareness that word order signifies which VIC object is to be considered the location. First, reminiscent of an earlier strategy successful in dealing with the action-object relation, the patient locates all objects indicated in the utterance and places them below their respective symbol cards. He then "fixes" the object referred to last—i.e., to the right of the preposition—by holding it firmly on the table below its symbol card, and then places the other object in relation to it as indicated by the action and preposition cards. Thus, directed to place the fork to the right of the spoon, the patient first fixes the spoon beneath its symbol card and then places the fork to the right of it. Response to this particular command proves an especially telling indication of the patient's strategy because the correct response requires placement of the indicated objects in a left-right orientation opposite to that occupied by their symbol cards in the utterance. In watching a patient go through such a sequence, one cannot help feeling that one is watching—in externalized form—the kinds of mechanisms that underlie comprehension of all sorts of symbolic messages (cf. Vygotsky[14]).

DISCUSSION

What Has Been Learned in VIC

The strategies utilized in the patient's attempts to deal with the specific semantic relations described above present a relatively consistent picture of how the predicative function of semantic relations in general are dealt with, differing primarily to the extent that a two-step treatment of the symbols that comprise each relation precedes a smooth, seemingly automatic response to the relation as a whole. Ranging from an obvious demonstration of the two-step treatment of the action-object relation to a simple noting of name symbol cards before responding to an utterance that includes the action-beneficiary relation, patient strategies indicate that mastery of each relation evolves gradually.

That this course of mastery reflects many of the general properties of learning—e.g., error rates go down as patients acquire familiarity with the system; regressions occur; isolated acts eventually become combined—is not surprising. At issue, however, is the *nature* of that learning. Is the successful VIC patient fully aware of the communicative impact of the symbol cards when organized into messages, or is he responding to them, albeit in an apparently appropriate fashion, simply on the basis of such correlated but communicatively irrelevant conditions as length of utterance, presence or absence of the "box" or "glass" symbol card, and so on?

One might sketch out three possible levels of understanding of VIC. One extreme is represented by the view that VIC is simply a card game. A patient of this persuasion would simply learn which cards should be laid out, or which responses made, when the therapist has laid out certain other cards. While some patients have indeed regarded VIC in this manner, they cannot have passed through the steps outlined here, for even these steps invariably require at least some attention to elements other than the therapist's cards.

The opposite extreme in understanding would entail a genuine appreciation of VIC as a viable means of communication. Here the patient is aware that the cards can be used to capture his ideas and feelings, and can also be read as indices of the thoughts and intentions of others.

An intermediary degree of understanding is also possible and indeed may characterize some of the patients in the VIC program. Such a patient is aware that the cards relate to events in the external world; and so, in producing and reading VIC messages, the patient carefully correlates the cards with the objects and actions in his view. However, the exercise of VIC ceases for such patients once they have left the VIC session. The possibility that the cards might be used universally as a viable mode of communication is foreign to them.

It is extremely difficult to make a decisive determination about the level of understanding of VIC patients, understanding which indeed may alter or remain in flux over the course of training. Nonetheless, some indices can be noted. In a case of genuine appreciation of VIC's potential for communication, for example, card use by the patient is prompted not only by situations that demand such a response, but by his own needs, wants, fears, and so on. Patients falling into this category would include those who have proceeded to Level 2 of VIC and, in the process, have spontaneously used their cards to request cigarettes and matches when they wanted to smoke, to ask when they would be going home when that was their foremost concern, and so on.

On the other hand, indications of purely game-like strategies are revealed by the following forms of patient behaviors:

1. Slavish matching of *specified* elements in VIC questions (e.g., in answer to the question "Who put what in what?", the "put" and "in" symbol cards are located first and placed directly underneath their niche in the question).
2. Responding to commands by matching them with cards from the patient's own set.
3. Consistent use of the strategy for ordering elements in a "put in" utterance (i.e., the "box" or "glass" symbol card occurs generally in the final position) in the case of utterances where such ordering is irrelevant (e.g., "Brian give comb and glass (to) John").
4. Use of habitual answers to questions without regard for the consequences. For instance, in answer to the question "John want cigarette?," the patient may answer "yes," yet indicate no interest in smoking the cigarette given to him. Or the patient may respond with "John feel happy" to the question "John feel what?," even when he is manifestly in a depressed mood.
5. Persistent inability to place symbol cards in their appropriate form class piles.
6. Excessive and inappropriate reliance on social cues (e.g., facial expression of therapist or other VIC communicators); focusing on the positive or negative feedback rather than other consequences of the responses.

Intermediate between response to VIC as a card game and its use as a genuine means of communication lies a broad, less easily delineated mode of behavior. Clearly, the patient who, upon presentation of the "Write It" card, describes correctly an action carried out before him has sampled the real world in determining his response. His use of VIC cards in this case reveals none of the game-playing strategies described above, relying instead on communicatively relevant conditions particular to the situation. It may, in fact, be the case that the vocabulary available to the patient in Level 1 of VIC leaves little room for a more sophisticated view of the system. Perhaps only in Level 2 can the patient appreciate the possibility of using VIC as an effective and versatile means of communication.

The mark of the successful VIC subject, then, is a full appreciation of the nature of the system. Unlike the normal person, to whom the system can be explained, and unlike the child whose appreciation of language as a means of communication appears to develop gradually and naturally, the patient entering VIC is confronted immediately with a new situation which itself must be decoded—i.e., he must learn how and what to learn in the context defined by the VIC scenario. Learning of this type, variously called set learning, learning to learn,[15] and deuterolearning,[16] must be a totally bootstrap operation for the severely impaired aphasic. Inevitably ignorant at first of VIC's potential value as an alternative to his vitiated language, he is unable even to isolate the "meaning" of a particular symbol or symbols as the source of his confusion. His challenge is to figure out the system on his own through observation of other individuals using VIC, feedback to his own responses, and spontaneous use of the system, as well as whatever additional clues may emerge from this process.

The strategies described above speak to the question of what the successful VIC patient has learned. His ability to learn four basic semantic relations certainly counts as evidence that a certain communicative aspect of the system has been appreciated. Yet, even though the typical patient eventually demonstrates an ability to respond to and utilize these relations, it cannot be categorically stated that he regards particular constructions as *expressive* of those relations. Nevertheless, to the extent that the patient can successfully generalize strategies for particular semantic relations to utterances containing newly introduced name, verb, object, or preposition symbol cards, at least some appreciation of the predicative function of those semantic relations may be assumed.

Regarding this point, it is instructive to note that a patient's performance on the "picture arrangement" subtest of the Wechsler Adult Intelligence Scale, which requires that eight sets of pictures be arranged in such a way that each set depicts a logical sequence of events, has generally proved to be a reliable indicator of the patient's success in VIC. It is tempting to speculate that the patient who is at least able to *think* about sensorimotor patterns as forms of action in the real world, and can demonstrate as much via the sequencing of pictures, is perhaps better equipped to deal with VIC utterances as *expressions* of forms of action realized in the formal relations obtaining among the symbols that comprise those utterances.

Yet, mastery of these semantic relations proves to be only the first in a series of steps necessary in acquiring a fuller appreciation of the system's potential for communication. Of great importance is the ability to respond to interrogative particles in VIC questions (e.g., "who," "what") as requests for specification of constituents, and, further, to specify those constituents even when they are not explicitly asked for, as when the "Write It" card is employed by the therapist. Only as patients have the opportunity to utilize the system to express semantic relations under a variety of conditions can we gain strong evidence that they are appreciating the *full* significance of each particular relation.

At present, VIC contains only a limited number of the grammatical morphemes and sentence types that constitute the later stages of language development in the child. And even this small set of properties that extend beyond the basic semantic relations has been mastered in their entirety by only a few VIC patients. It is therefore premature to speculate about the degree of symbolic complexity and understanding of the system which might eventually be acquired by VIC subjects. Nonetheless, it is interesting to note that, with few exceptions, patients have experienced considerable difficulty in learning the grammatical morphemes in the system: and/or, in/on, in front of/behind, to the left of/to the right of, and verb tenses. There are various possible reasons for these difficulties, some of which may be quite apart from the linguistic facets of these constructions. Yet it is at least tempting to speculate, even as it is consistent with recent findings in aphasiology,[17] that the ability to handle the more purely computational aspects of a symbolic system—be it natural language or VIC—is particularly devastated in the case of a severe aphasia.

COMPARISON WITH OTHER SUBJECTS LEARNING A FIRST SYMBOL SYSTEM

In a way, the young child represents an ideal in the acquisition of a new symbol system because he epitomizes both facets under consideration here: an obvious communicative facility, coupled with eventual mastery of the computational mechanisms that govern symbol use. Within a few years, he evolves from communication which is entirely unmediated (e.g., crying when hungry or uncomfortable), to communication which utilizes a variety of symbol systems.

With respect to language, the normal child acquires early on the operation of matching names and referents and an appreciation of the semantic relations described above, demonstrating these capacities in a proliferation of spontaneous utterances. And in an overwhelming majority of cases, the word order of such utterances parallels adult usage of word order, assuming that the child intends to express the semantic relations suggested by context (cf. Brown[5]). Further, as the child's use of language extends to include modulations of meaning within the simple sentence, various sentence modalities, embedding of one sentence within another, and coordination of simple sentences—the milestones of Brown's Stages II through V—the linguistic abilities reflected in the use of such operations become increasingly complex. In these respects, aphasic patients in the VIC program could do no better than to emulate the child.

Unfortunately, instances of spontaneous VIC use are at a minimum. Whether due to age, personality change, or the effects of cortical damage, aphasic patients characteristically demonstrate little curiosity or interest in the world around them or in communicating via whatever skills remain at their disposal (e.g., simple gesturing). Carried over into the VIC program, insufficient motivation can preclude success at even the simplest level—recognition of VIC cards as symbols. In the absence of spontaneous VIC use by patients who have otherwise demonstrated proficiency with the system, we have in this paper discussed two alternative indices: the patient's capacity and intention to convey various semantic relations in utterances of his own, and the dearth of "different category" and word order errors evidenced in those utterances.

Although even the most successful VIC patient does not use the system as productively or spontaneously as a child language-user, he is at the same time readily distinguished from the autistic child who, if he uses language at all, does so in a ritualistic and generally echolalic fashion. Slavish repetition of utterances like "I am eating my lunch" provides perhaps the purest example of language used solely as a game. It is intriguing that "echolalic" matching in VIC has occurred in only one patient who presented with the syndrome of transcortical (or "echoing") aphasia.

Until recently, the major attempts to teach new symbol systems to infrahuman primates have focused on either communicative facility or mastery of computational skills, the one in the absence of the other. Although the chimpanzee Washoe[18] has demonstrated mastery of over one hundred signs in American Sign Language and uses them spontaneously in various combinations, she apparently has indicated little proclivity to order her utterances in the same way her human teachers do, or to reflect a consistent ordering of her own design. Another chimpanzee, Sarah,[19] on the other hand, in her use of variously shaped and colored tokens, has demonstrated an impressive mastery of certain computational mechanisms entailed in natural language, while evidencing little interest in using her token-language spontaneously.

However, Lana's performance with Yerkish[20] seems relatively unexceptionable. She uses her newly acquired symbol system to ask spontaneously, and often, for food, movies, or whatever, and to comment on various elements of her environment; moreover, she reflects in her utterances a consistent use of word order. Such "invented" requests as "Please machine move into room" and "Please machine tickle Lana," while in one sense inappropriate, offer convincing evidence that she has indeed mastered the semantic relations described above.

To be sure, Yerkish incorporates little that is more complex and demanding than the semantic relations of Stage I, and therefore the extent to which her "final" symbol system will resemble natural language remains to be determined. Nonetheless, in view of the criteria for a communication system cited here, her performance is most noteworthy. Indeed, based on our findings and those of other investigators, it seems that the ideal learning situation may be one that combines a naturalistic setting—in which enjoyment and comfort is dependent upon use of the symbol system—and a relatively operant training procedure that reinforces only those utterances that honor the rules of the system.

CONCLUSION

The success of aphasic patients in mastering Level I of VIC, and the various strategies that provide a window onto how and what they have learned, suggest that at least some of the capacities necessary for language use may be spared in brain-damaged individuals, even when language itself is gone. In the course of the program thus far, we have adduced a moderate amount of evidence for communicative facility with the system and mastery of at least some of the computational mechanisms that govern VIC use. The challenge now is to expand the system itself to make it, on the one hand, more relevant to the patient's everyday life and, on the other, capable of carrying greater syntactic complexity.

Toward this end, we are currently exploring a provision for inflecting verbs with respect to tense, an operation that would allow at once for greater flexibility in VIC syntax, as well as communication about people, events, and so on, outside the immediate VIC context. In addition, we are experimenting with the use of "operators," plastic overlays which either modify object symbols (e.g., "large, yellow pencil") or change their semantic roles (e.g., an agent operator converts "letter" to "mailman"; a location operator transforms "football" to "stadium"). Strategies employed by patients in dealing with these and other semiotic functions hold much potential for revealing valuable clues into the aphasic patient's linguistic abilities beyond those indicated by his success with semantic relations. Only then can we better assess the extent to which an artificial symbol system like VIC actually can assume the basic communicative functions of natural language.

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